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## Vertical integration in Italian pasta supply chain: A farm level analysis

This paper aims at identifying what features are relevant in characterizing the vertical coordinated farms in Italian durum wheat sector. Vertical coordination of food supply chains is deemed as a necessary strategy to optimize the production system, helping processors to face the global competition and allowing farms to get more distant markets accessible. However, in Italy a form of vertical coordination in the pasta supply chain is diffusing, and despite the potential advantages of this relationship, the majority of durum wheat is sold through spot contracts typically underwritten with commercial intermediaries. Using data from the Agricultural census, the empirical analysis suggests that the integrated farms are more sized and professional and have a greatest focus on product quality.

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### 1. Introduction

The agro-food sector has experienced a recent growth of contracts directed to coordinate transactions between the agricultural production and the processing or distribution stages in both USA and Western European countries (Jang and Olson, 2010). In Italian pasta supply chain a particular form of vertical coordination (supply chain contract) is diffusing (Zanni and Viaggi, 2012) pushed by some of the biggest Italian pasta firms, that follow a market approach based on a quality leadership. Specifically they offer pasta made with particular types and varieties of durum wheat (for example pasta made with 'Italian 100% grains'), consequently they have the necessity of ensuring a stable supply of durum wheat, territorially traced and/or with specific attributes. This form of coordination is generally characterized by an overall framework agreement signed by the main stakeholders involved in the supply chain, such as farmers, seeds and chemicals producers, dealers and food industry, often sustained and supported by policy measures (within the regional programs for rural development).

Within this structure of agreements, the formal relationships with producers and processors are regulated by contract farming, designed with enriched details in order to set not only the pricing mechanism (combining price to

quality standards), but also the definition of a minimum volume of product to be delivered by farmers, and provisions and obligations for transferring production technologies and inputs provided by the 'supply chain' contractors (seeds, fertilizers and chemicals).

By contract farming, participant farmers could reach a comparative advantage allowing them to tap the latent demand of better-off or more distant markets made accessible by emergent agricultural value chains and typically improve their productivity and profitability, thereby further stimulating commercial demand and supply (Barret *et al.*, 2012). Benefits, such as secured market access and reduced price risks, enhance farmers' contract motivations (Davis and Gillespie, 2007; Drescher and Maurer, 1999) and are thus important arguments for entering into contractual relationships.

In addition, since the contract farming often includes the provision of seed, fertilizer, and technical assistance on credit and a guaranteed price at harvest, it is a form of vertical coordination that simultaneously solves a number of constraints on small farm productivity, including risk and access to inputs, credit, and information. In this view, contract farming is an institutional solution to the problems of market failure in the markets for credit, insurance, and information (Grosh, 1994; Key and Runsten, 1999). Then in Italy, where farms are predominantly small sized, a number of policy measures were introduced to facilitate the development of such forms of contracts. These interventions provide co-financing support for investments, as well other forms of incentives to the actors involved in supply chain's partnerships.

Though positive effects may derive from collaborative contracts, however, the majority of Italian durum wheat is sold through spot contracts typically underwritten with commercial intermediaries (Solazzo *et al.*, 2015; Zanni and Viaggi, 2012). Some frictions would explain this situation. Farmer's attitudes and personal motivations towards contracting are often decisive factors, but also some characteristics of farms, such as size, productive specialization degree, localization, etc., may favour or not a cooperative approach of their marketing relationships.

Since the choice of vertical coordination may depend on a number of farm' and farmer' characteristics, the analysis and understanding of these features can help policy interventions in targeting farms more likely to join contracts. Despite the relevance of these features in determining vertical integration in agriculture, there is lack of studies in Italy that empirically investigate on these issues, so it remains an important subject to be explored both for policy and research reasons.

This papers analyses data from the Italian farms census to test if there are farmers' and farm's characteristics that are systematically associated with vertical coordination. The regression model includes an outcome variable iden-

tified by the percentage of durum wheat that is directly sold to the industry over total sales. I would emphasize that this is an innovative proxy variable representing an attempt to measure the level of vertical coordination of Italian farms, that tries to overcome the lack of specific information provided by official statistics.

To sum up, our findings have pointed out that larger-sized farms and more professional farms with complex organization (corporation or 'legal person', prevalence of salaried workers, full-time farmers) are more coordinated. Our analysis also highlights that a greater focus on products' quality improves farm's propensity to coordinate with their buyers. On the other hand, it doesn't seem that some of farmer's characteristics, such as age and gender, have impacts on vertical coordination degree of farm; whereas higher education and training and full-time status of farmers appear to be significantly correlated with highest coordinated farms.

The heterogeneity observed for the two groups of farms underlines the relevance of analysing these characteristics in understanding vertical coordination in agricultural markets. Above all the way in which they evidence the channels through which the policy can promote the cooperation between farms and industry and plan more focused public interventions.

The remainder of the paper is structured as follows: next section reports some of the main theoretical and empirical literature focused on such topic, section 3 illustrates methodology and data used, section 4 shows the results and last section concludes.

## **2. Literature background**

The effective vertical or chain relationship are often considered a key source of competitiveness for firms (Fisher *et al.*, 2008) and as a promising opportunity for value creation in rural economies and agro-food industry (Barney and Hesterly, 2011). The underlying reasons for more vertical coordination are the reduction, as well as the sharing of income risk, enhanced performance, and the reduction of transaction costs (Balmann, 2006).

Vertical cooperation between farms and food processors could be established through informal long-term relationships, marketing or production contracts, and contract farming. Contract farming is often used to manage integration, coordination and cooperation because it provides flexibility in the way incentives can be set for different typologies of suppliers, thus increasing the chances of large participation (Abebe *et al.*, 2013).

Contract farming can be defined as a form of 'non-equity' vertical integration between agricultural producers and buyers (exporters, agro-processing

companies or retailers) at the end of the value chain. From a theoretical point of view, the most of empirical literature, aiming at analysing contract farming and other institutional arrangements in vertical coordination of supply chain, has referred to 'New institutional economics' (NIE). The most important concepts of NIE are related to transaction costs, uncertainty, risk, market imperfections (in capital, land and labour), coordination failures (especially for the introduction of new crops or technologies), efficiency and monopsony rents, that are used to explain the willingness of contractors to offer incentives to farmers and the farmers' responses to incentives and threats. More specifically, based on this theoretical framework economists concentrate on the micro-functioning of contract farming arrangements following a functionalist approach that focuses on the role that this institution plays for both contracting parties (Oya, 2012).

Although contract farming dates back to 19<sup>th</sup> century (Vermeulen and Cotula, 2010), particularly today is used to varying degree in almost every country in the world being a key factor in promoting the production of high-value products (Morales *et al.* 2013). Nowadays more quality is required for food products as the current demand is more oriented to a responsible consumption and attention to the healthy and nutritional values than in the past. Many food scandals, for example, strongly affected consumers' attitude, making food safety one of the most issues of product quality for both consumers and retailers, and had important effects on the supply chain organization (Mora and Menozzi, 2005). Moreover, in developed countries health problems linked to unhealthy diet (such as obesity, allergy, diabetes, etc.) have established an increasing attention of consumers on nutritional values and on naturalness and traditionalism of foods. Consequently, the producers need acquire detailed information concerning key elements for raw material and its growing process, to provide assurance of product quality and authentication of process/product claims.

On the other hand, as some of literature has documented, the application of new biotechnology in crop breeding has accelerated new variety development in corn, soya, wheat and canola sectors, leading to increase product differentiation and market segmentation (Jang and Olson, 2010). Food industries and supermarkets that follow a product differentiation strategy, in order to ensure them have access to a stable supply of commodities satisfying specific quality requirements, they rely on complex supply chains in which raw materials are produced under contract rather than relying on commodities purchased at the farm gate or on spot markets (Reardon *et al.*, 2009). So, food quality has been a key driver for more contractual relationship types in the food chain and the certificate signalling food safety poses a strategy to avoid adverse selection (Fischer *et al.*, 2008).

Supply chain coordination is then a necessary strategy to optimize the production system, helping food industry to face the global competition (Bertazzoli *et al.*, 2009). By vertical coordination also participant farmers could reach a comparative advantage. For example, contractual farming advantages to the farmers derive from reducing price risk volatility, no longer mitigated by the Common Agricultural Policy (CAP), by subscribing a minimum price guaranteed contract (Carillo *et al.*, 2015; Zanni and Viaggi, 2012). The contracting producers may also reduce transaction costs related to the search for buyers and may benefit from technical assistance that could increase their capacity to generate a marketable surplus. This last aspect represents a certain advantage for farms with limited economic size usually unable to access to private agricultural extension services (Carillo *et al.*, 2015). The production technologies available to and appropriate for smallholders can be similarly limiting, so contract farming by transferring technologies and inputs can improve the quality of production (Barret *et al.*, 2012). Finally, institutional constraints, such as limited access to credit and insurance and uncertainty regarding new risks may further increase the feasibility and attractiveness of contract farming participation for smallholders (Barret *et al.*, 2012). In this view, contract farming is an institutional solution to the problems of market failure in the markets for credit, insurance, and information (Grosh, 1994; Key and Runsten, 1999).

Despite the potential advantages of such contracts some frictions are present in Italian grain sector that limit the diffusion of collaborative agreements. Farmer's attitudes and personal motivations towards contracting are often decisive factors for farmers' decisions concerning the conclusion of contracts (Guo *et al.*, 2005; Key and McBride, 2003; Kularatna *et al.*, 2001; World Bank, 2005). Drescher and Maurer (1999) show that fear of losing autonomy and of being at the mercy of one market partner hinders the establishment of contracts and Boessen *et al.* (2010) find that 'independent' producers are more likely to reject marketing contracts. The fear of losing entrepreneurial freedom is also confirmed by other authors (Key, 2004; Key and MacDonald, 2006; MacDonald *et al.*, 2004). It was additionally highlighted that some features of farms, such as size, productive specialization degree, localization, etc., may favour or not a cooperative approach of their marketing relationships. It is often only the well-endowed and skilled farmer that has the ability to be part of these coordinated marketing chains and alliances (Kirsten and Sartorius, 2002). On the other hand, the agribusiness firms are generally in dominant position that can lead to abusive clauses or asymmetrical distribution of earnings, consequently some disadvantages for farmers may arise from contract farming (Singh, 2002; Morales *et al.*, 2013).

In the next section, I will focus on such variables that could affect the farm's participation to contracts.

### 3. Data and methodology

The data derive from the Italian Agricultural Census, collected by ISTAT in 2010<sup>1</sup>, and were limited to farms with durum wheat production with less than 15,000 euro of total standard output<sup>2</sup>. This restriction was applied to exclude the excessively small-sized farms (Sotte, 2006; Carillo, 2011; Arzeni and Sotte, 2013) and, consequently, to gain a better understanding of the behaviour of those farms which have a sufficient production capacity that allows them to choose the best approach to their markets.

The outcome variable is a percentage of ‘direct industry selling’ and the explanatory variables represent the main features of farm’s structure, of technology used and of farmer’s personal characteristics. The independent variables are selected coherently with the empirical literature, chosen in order to analyse the factors associated with farm’s choice of marketing relationship.

Several difficulties make the study of these relationships complex, including the measurement of vertical coordination degree of firms. I have quantified vertical coordination using the percentage of durum wheat directly sold by farm to industry over total sales (farmer-processor channel). Since the marketing direct-industry channel is usually based on formal contract, which determine in advance delivery schedule, pricing method, product characteristics and, very often, productive techniques and technical inputs that farmers bind themselves, we could be confident on the representativeness of this proxy variable.

The control group is represented by those farms that sell through intermediaries as they represent the opposite choice, *id est*, the longest traded channel. Then, the analysed sample covers 37,870 total farms, 4,943 of which (around 13% of total) are selling directly to industry (coordinated farm, hereafter CF).

Considering the continuous dependent variable (varying from 0 to 100), the technical approach used is an *Ordinary Least Squared (OLS)* regression, absorbing regional indicators to take account of the fixed effects that could bias the estimates. This approach takes into account unobservable geographical, institutional and historical factors that vary across regions.

Formally we have:

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<sup>1</sup> Individual data (at farm level) have been used, thanks to the participation of the former INEA (now Council for the Agricultural Research and Economics - CREA) in the National Statistical System (SISTAN)

<sup>2</sup> The total Standard Output (SO) is the overall economic size of farms and it is given by the sum of the SO, expressed in euro per hectare of crop and per head of livestock, attributable to each activity present in the farm. SO is the average monetary value of the agricultural output at farm gate price.

$$Int_i = \alpha + \beta_1 K_i + \beta_2 X_i + \beta_3 H_i + \beta_4 F_i + \varepsilon_i \quad (1)$$

Where  $Int_i$  is the percentage of wheat sold directly to the processing industry by the  $i$ -th farm whose value can vary from 0 to 100,  $K_i$  is a vector of covariates representing the structure of the farms,  $X_i$  is a vector of the independent variables related to technology,  $H_i$  is a vector of variables related to personal characteristics of farmer,  $F_i$  is a vector of regional dummies and  $\varepsilon_i$  is the error term.

### 3.1 The farm structure

About structure, I used the natural logarithm of ‘utilized agricultural area’ (UAA), expressed in hectares, as proxy of farm size. On this respect, we have to take into account that previous results, shown in the existing literature, are mixed and so different and opposite effects may follow from this relationship. According to some studies, mainly focused on developing country, in many sectors the small-scale family farms are more vertically coordinated through contract farming than larger ones (Ochieng, 2010; Jaffee, 2003; Oya, 2012; Glover and Kusterer, 1990). The main explanations provided are that, by contracts, farmers can offset fluctuations emerging in the spot market, thus eliminating price risks and than small farms should be more interested in this market arrangement. Furthermore, such contracts, by transferring production technologies and inputs, can improve the quality of production (Barret *et al.*, 2012) and this is especially relevant to small farms, which are limited in the availability of appropriate production technologies. Other authors underline that larger farms are more reluctant to be ‘locked’ into exchange relationships with one buyer (Gërdoçi *et al.*, 2016). Consequently at these evidences, I would anticipate that small farms are most likely to participate in coordinated contracts, also in Italian pasta chain. On the other hand, according to other scholars mainly focused on developed countries, contracts farming are more often to be used by large farms than on small ones (Kirsten and Sartorius, 2002; MacDonald and Korb, 2008; Jang and Olson, 2010). So, I couldn’t hypothesise in my model a clear effect and direction of this relationship.

Another variable we have used as explanatory variable is the percentage of farm’ revenues deriving from alternative markets with respect to agriculture market *stricto sensu*, representing the farm diversification. Normally, farm diversification is understood as the creation of any gainful activities that do not comprise any farm work but are directly related to the holding i.e. use its re-

sources or products, and have an economic impact on the holding. On this relationship some of the existing literature proves that vertical contracting is closing more on-farming specialization (MacDonald and Korb, 2008) and, then, we are confident with a prediction of a negative and significant coefficient.

Moreover, the percentage of revenues attributable to direct payment provided by Common Agricultural Policy (CAP) indicates the dependency on the public subsidies and, in some way, on the farm's ability to stay on the market. On this relationship I could expect a negative sign because higher is the percentage of revenues deriving from the market higher is the uncertainty and riskiness of farm income respect to such revenues secured by subsidies. Consequently, as underlined in some empirical papers, a minor percentage of public payments increases the likelihood for farmers to establish sustainable (lasting) relationships with buyers (Gërdoçi *et al.*, 2016).

Finally, I utilized two dummies as a latent variables of the management's professionalism degree and of organizational complexity of farms. In particular, one of these is relating to legal personality of the holding, which is equal 1 if farm has an 'individual legal form' (*id est*, when a natural person is a sole holder). Another dichotomous represents if the farm labour force is in prevalence composed of 'employees', these last ones are all people performing farm work and receiving any kind of remuneration, such as salary, wages, profits or other payments including payment in kind, from the agricultural holding, other than the holder and members of farmer's family. Then, through both of the coefficients of these variables, I can predict if there is a direct relationship between an higher professionalism and more organizational complexity and more coordinated farms.

### 3.2 Technology measures at farm level

For technology I use the following variables.

The hectares dedicated to the cultivation of durum wheat, expressed in percentage of UAA, are utilized as a proxy for the specialization degree of farm production in one crop. This may highlight an highest or lowest productive risk of farming and the possibility of whether or not exploiting productive economies of scale.

Another explanatory variable is the quota of UAA used for organic products, that represents the focus of farms on market niches characterized for the selling of highly qualitative products and contextually for the environmental sustainability of production. This last aspect is ascribable to the fact that the key principles and practices of organic food production aim at encouraging and enhancing biological cycles within the farming system to maintain



and increase long-term fertility of soils, to minimize all forms of pollution, to avoid the use of synthetic fertilizers and pesticides and to maintain genetic diversity of the production system. Then, organic agricultural and food processing practices generally seek to foster the development of a food production system that is ecologically sustainable. However, the environmental aspects are particularly measured in my model by other two variables: the portion of arable land treated by conservation (low) tillage and the percentage of crops that is grown continuously (monoculture). The system of tillage practices are techniques that leave plant residues (at least 30%) on the soil surface for erosion control and moisture conservation, normally by not inverting the soil, while the monoculture is when crops of the same species are grown without interruption on the same field.

I also underline that organically labelled products are considered of high quality by consumers (in healthy and nutritional values) therefore allowing firms to capture a premium price. In this view, I could hypothesize a positive coefficient for this relationship because a more vertical coordinated arrangement is established by those firms that want to ensure distinctive attributes for raw materials since they can hardly be found on the spot market. At the same time, also farms that invest in highly specific production aim at looking for the market arrangements to ensure in advance the selling of their products. So they are more likely to choose coordinated marketing contracts instead of relying on spot markets.

Finally, the use of computer for farm management, represented by a dummy equal one if it occurs and zero otherwise, is used as proxy variable of overall technological progress of farm.

### 3.3 *The farmer*

In this study, I also consider personal characteristics of farmer, that can affect his/her propensity to be vertical coordinated.

Primarily, I will estimate the effect of farmer's age on the type of market's option chosen for selling. This variable may particularly be considered as a proxy of experience of farmer in farming and of the presence of his/her consolidated relationship with buyers. In this sense, I might expect that elderly and experienced farmer has established long-term relationships that can more easily flow into vertical coordinated agreements. At the same time, however, if we consider that this type of contract is an 'innovative way' to stay on the market, we may imagine that young farmers are more likely vertically coordinated. In the same direction, some scholars argue that the long-term orientation of business partners is a necessary condition to the establishment of

contractual as well as non-contractual cooperation (Kalwani and Narayandas, 1995; Morgan and Hunt, 1994), so the age of farmer could be a relevant variable if we take into account that young people have a longer time horizon than older ones. Based on these considerations, I couldn't hypothesise a clear effect of this variable on the outcome.

In the model I have also considered two variables related to farmer education: the formal education level, expressed in years of schooling, and additional formal training, which is represented with a dichotomous equal 1, if farmer attended any courses, and 0 if not. With respect to the last variable ('vocational training') we refer to a training measure or activity provided by a trainer or a training institution which has as its primary objective the acquisition of new competencies related to the farm activities or activities related directly to the holding or the development and improvement of existing ones. About formal education, a previous research (Anim, 2011; Singh, 2002) has shown that the use of written and more complex contracts most likely requires a deeper understanding and knowledge of the legal and commercial obligations and rights that a producer would be willing to accept if he or she signs an agreement with an agribusiness firm. However, in general, the education of farmers is considered important because better-educated farmers are better able to negotiate with agribusiness firms (Chiriboga *et al.*<sup>3</sup> as cited in Morales *et al.*, 2013). Thus, producers with less education are less likely to use vertical coordinated contracts.

The gender, reported in the model with dummy equal 1, if male, and 0 otherwise, is considered in some literature (mainly focused in developing countries) a relevant variable, because in family farms contracts are generally signed by the heads of families, who in many cases are men (Eaton and Shepherd, 2001; Morales *et al.*, 2013).

A dummy equal 1, if it is prevalent an extra-farming activity, and 0 otherwise, was used to identify the status of 'part-time farmer', that is, if other gainful activities, other than farm work for remuneration, are carried out as his/her major occupation. The pluri-activity of farmers was used because it could be an element that affects the behaviour of farmer about farm riskiness. In fact, farmer who earns most of their income from farming is probably more risk-averse than a part-time farmer. The farmer's risk attitude is also a key variable in the use of contract farming because farmers minimize their risk through contracts. Then, I predict a negative relationship between the part-time farmer and farm's vertical coordination degree.

The Table 1 provides some statistics relating to all variables used.

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<sup>3</sup> Chiriboga M., Chehab C., Vazquez E., Salgado V., Recalde, O. (2007). *Mecanismos de articulación de pequeños productores rurales a empresas privadas PPR-EP*. Informe Nacional Ecuador Rimisp. Plataforma Regional Andina. Quito, Ecuador, 7-64.

**Tab. 1.** Descriptive statistics of variables for industry-selling and intermediary-selling farms

Variables	Industry selling		Intermediary selling	
	Means	Standard deviation	Means	Standard deviation
Observations (N°)	<b>4,943</b>		<b>32,927</b>	
K: Farm's structure				
<i>utilized agricultural area (UAA) (hectares)</i>	53.26	113.81	37.57	59.81
<i>UAA of durum wheat (%)</i>	40.91	25.83	45.28	25.54
<i>direct payment value (%)</i>	25.89	23.39	32.06	23.88
<i>other gainful activity (%)</i>	11.74	31.47	9.57	28.98
<i>individual legal form (dummy)</i>	0.85	0.36	0.92	0.28
<i>operating with salaried (dummy)</i>	0.11	0.31	0.07	0.26
X: Technology				
<i>UAA in organic cereals over UAA in wheat (%)</i>	4.67	0.30	4.63	16.33
<i>UAA with conservation tillage over UAA in arable crops (%)</i>	4.34	16.17	3.71	14.79
<i>UAA in monoculture over total UAA in arable crops (%)</i>	4.58	16.30	3.07	14.80
<i>presence of computer (dummy)</i>	0.15	17.51	0.09	0.28
H: Farmer's characteristics				
<i>education of farmers (years of schooling)</i>	9.81	4.35	9.51	4.40
<i>training courses (dummy)</i>	0.13	0.34	0.10	0.30
<i>age (years)</i>	54.32	15.28	54.5	15.3
<i>male gender (dummy)</i>	0.77	0.42	0.73	0.44
<i>extra- farm activity prevalent (dummy)</i>	0.10	0.29	0.12	0.32

Source: our elaborations on Italian Agricultural Census (2010)

#### 4. Results

Table 2 depicts the OLS estimates of four regressions of Y on X. In the first I have only utilized the explanatory variables concerning farm structure, in the second I have only used those ones of technology, in the third the variables are related to farmer characteristics, finally in the last regression all variables are included. It should be outlined that since the farmer level data are

available for a subset of individual farms, the two last regressions were restricted to such farms, reducing the number of observations to 36,969.

#### 4.1 Farm's structure

Our findings show that depending on the size of the farm, farmer will tend to choose one or the other option (of being coordinated or not coordinated). In effect, we can see in Table 2 at column 1 that the coefficient of UAA, utilized as proxy of farm size, is positive and significant. In particular, because the outcome variable is expressed in percentage and the UAA's hectares were transformed in natural logarithm we could interpret the coefficient directly as elasticity. Then, the estimated magnitude of coefficient suggests that 1% of increment of UAA increases the vertical integration level by 0.9%. This variable making regression with all independent variables remains significant (Tab. 2, column 4).

The negative coefficient of dummy for individual legal form shows that juridical form such as group of natural persons or legal person are prevalent in the CF. This evidence should imply a more complex administrative organization and highest professionalism of management. These traits are also visible by the coefficient of variable 'not-family workers prevalent'.

The percentage of revenues assured by CAP's direct payments have a negative coefficient's sign, consequently showing a lowest dependence on subsidies of CF and, then, their greater market orientation. Therefore, we say that the dependence on public subsidies curbs the farms to comply with the growing contracts or other forms of coordination with industry. This variable remains significant also in the fourth regression (Tab. 2, column 4).

The negative coefficient of a percentage of extra-agricultural activity shows that CF are heavily specialized in farming and suggests that CF shouldn't search alternatives to remain profitable and competitive. Conversely, the negative coefficient of the 'grain' specialized index' (*id est*, the percentage of hectares of durum wheat over total UAA) shows that CF is lesser specialized in the wheat sector than in not coordinated ones. We emphasize that both of these variables persist in significance also when I make regression of complete model (Tab. 2, column 4). So we can say that they try to diversify the productive risk while remaining in the agricultural sector.

In conclusion, about farm's structure we could state that the largest and better endowed farms have a greater ability and superior facilities in adhering to coordinated marketing relationship.

## 4.2 *Technology*

About technology, first of all we can see that a coefficient of the hectares' percentage in organic production is positive and significant (Tab. 2, column 2). This finding shows that CF adopts more widely organic techniques for wheat production and highlights its greater focus both on product quality and environmental sustainable production. This variable remains positive and significant also in the last regression (Tab. 2, column 4), then contract farming is shifting farm production away from staple grains and towards high-value commodities.

However, with respect to the environmental focus it should also be noted that CF more frequently produces arable crops in monoculture, even if crop rotation is strongly recommended to restoration of soil fertility. In this sense contracting seems to increase land-use intensity of farming becoming detrimental for productive environment. Moreover, the coefficient of percentage area in 'conservation tillage' is negative and insignificant, showing lesser attention to soil conservation and scarce interest on the utilization of such techniques that could increase productivity in an environmentally way. Moreover, because these productive techniques are more changeable in short time than other structure' characteristics seen before, we plausibly should consider these evidences as a consequential technological adjustments to contractual requirements or other marketable. So it can be stated that, by contract, processors are mainly focused on raw materials suitable for products marketable on quality niches rather than on the safeguard of the environment.

Furthermore, we found a significant and direct relationship between the vertical coordination and computerization procedures of farm, which remains significant in the model 4 (Tab. 2, column 4). It demonstrates a major complexity of farm organization and a more widely diffusion of appropriate technologies, and then we could say that more vertical coordination status should enhance the organization and technological ability of farms.

## 4.3 *Farmer's characteristics*

Finally, concerning the farmers' characteristics, the results show that age and gender have no influence on the type of market relationship chosen by the farm, in fact both coefficients are statistically insignificant (Tab. 2, column 3).

At the contrary, about education, either that one relating to schooling or other formal training, our results have shown that more education increases coordination degree of farms. However such variables become statistically insignificant when I regress the fourth model, probably because their correlation

Tab. 2. Results<sup>a</sup>

Variables	Y= selling industry (%)			
	Model 1	Model 2	Model 3	Model 4
<b>K: Farm's structure</b>				
<i>UAA (log of hectares)</i>	0.90***			0.83***
	(0.21)			(0.22)
<i>hectares of wheat over UAA (%)</i>	-0.03***			-0.04***
	(0.01)			(0.01)
<i>direct payment over total sales (%)</i>	-0.08***			-0.09***
	(0.01)			(0.01)
<i>extra-agricultural activity (%)</i>	-0.01*			-0.01**
	(0.01)			(0.01)
<i>individual legal form (dummy)</i>	-3.47***			
	(0.71)			
<i>management with salaried (dummy)</i>	1.18*			1.04
	(0.70)			(0.75)
<b>X: Technology</b>				
<i>UAA in organic cereals (%)</i>		0.03***		0.04***
		(0.01)		(0.01)
<i>UAA in conservation tillage (%)</i>		-0.00		-0.00
		(0.01)		(0.01)
<i>UAA in monoculture (%)</i>		0.06***		0.07***
		(0.01)		(0.01)
<i>Farm computerization (dummy)</i>		3.92***		1.96***
		(0.64)		(0.69)
<b>H: Farmer's characteristics</b>				
<i>education (log of years of schooling)</i>			0.87***	0.39
			(0.33)	(0.34)
<i>training courses (dummy)</i>			1.29**	0.66
			(0.58)	(0.59)
<i>age (log of years)</i>			0.27	0.68
			(0.60)	(0.61)

(Continued on page 61)

(Continued from page 60)

Variables	Y= selling industry (%)			
	Model 1	Model 2	Model 3	Model 4
<i>male gender (dummy)</i>			0.56 (0.36)	0.13 (0.36)
<i>extra- farm activity prevalent (dummy)</i>			-1.54*** (0.49)	-0.94* (0.49)
<i>Constant</i>	16.31*** (1.10)	11.20*** (0.18)	8.35*** (2.78)	9.50*** (2.84)
<i>Observations</i>	37,870	37,870	36,969b	36,969b
<i>R-squared</i>	0.050	0.046	0.044	0.051

Notes: <sup>a</sup> 21 regional dummies for fixed effects are introduced in all regressions.

<sup>b</sup> Because information of farmer are missing for companies these regression are limited to individual farms.

Robust standard errors in parentheses. Significance levels: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

with other variables (of structure or technology) confuse the estimations of entire model (Tab. 2, column 4).

The coefficients concerning the prevalence of extra-farm gainful activities (part-time status) is statistically significant and it remains so also in the fourth regression (Tab. 2, column 4) and the negative sign shows that CF's farmer is mainly involved in farming business. This highlights, in some way, a more professionalism of such farmers rather than of the CF's ones.

In conclusion, since farmers' characteristics cannot be easily modified in a short time, and then the variables are less severely affected by reverse causality, these results let us assert that highly educated farmers will undergo a self-selection process since they take part in more coordinated supply chains.

## 5. Conclusions

Vertical coordination of food supply chains is generally considered a marketing institution benefit for both processors and farms. It helps processors, in productive differentiation, to face the global competition and farms reach a comparative advantage allowing them to tap the latent demand of better-off or more distant markets made accessible. Contract farming is also considered a solution for a set of constraints on small farm productivity, including risk and access to inputs, credit and information. Therefore, it is considered as a

political solution to the problems of market failures faced by small-sized Italian farms, and several public interventions were implemented through rural development policy.

There is a wide part of literature analysing this topic, mostly in developing countries, whereas there are few studies about producers located in developed countries and even less in Italy failing to capture details of such farms that can be linked to modern supply chains. The paper focuses on these gaps by analysing different market channels (farm-industry *vs* farm-trader) utilized by Italian durum wheat producers. Subsequently two different institutional arrangements between farms and industries are compared and future characterizing two groups of farms are analysed. A linear regression model was applied on Agricultural Census data, limited to farms having equal or more than 15,000 euro of total standard output and only to those selling directly to industry or directly to traders.

The main findings show that the coordinated farms are more sized and professional than the not coordinated ones. These results indicate a lower participation of small-sized farms although many potential advantages could derive from contracts. The agribusinesses commonly offer suppliers reliable quality inputs (often on credit), technical advice extension, some degree of price guarantees, or a combination of these, thereby resolving financial, input or insurance market failures mainly for small sized farms through interlinked contracts. But our evidences are in contrast to this hypothesis, probably as a consequence of highest information asymmetries present in the contexts characterized by small farms, being the main constraint for small farms to subscribe contract farming. Moreover, the small-scale farming may discourage processors from establishing contractual framework with small farms because they aren't able to ensure enough quantities of wheat for their purposes. Consequently, as also claimed by some scholars, since large food companies prefer to work with medium and large scale growers, the smallholders will be marginalized, thus exacerbating rural inequality (Little and Watts, 1994; Singh, 2002). Our result also demonstrates that previous public interventions have failed in properly pushing Italian small farms into coordinated supply chain organizations.

The lowest dependence on subsidies of the coordinated farms show that they have a greater market orientation. Therefore, it would be argued that, in the past, the CAP's subsidies have generated some distorting signals inducing farmers to choose longer channels for their sales. On the other hand the lowest coordination degree should underline that contracting farmers through coordination seek to reduce marketing risk and stabilize income; in this sense, the integrator provides a form of insurance.

According to our results, it seems that the integrator also leads farms in having a greatest focus on quality of products when compared with alterna-



tive spot markets. It is likely that food processors in order to make sure a stable supply of raw materials with specific quality standards often oblige farms to use particular varieties of seeds and techniques for production. Then the processors of Italian pasta supply chain through contract transmit buyer-specific information aiming at obtaining specific product attributes which require unique production practices and that cannot be realized by after-harvest sorting (such as organic certification). Similarly for farms, searching for buyers and getting to know their quality requirements is difficult in an imperfect market environment, hence contract farming is expected to reduce farmers' quality uncertainty, because the quality demand of the buyer firm will be known *ex ante*. In this sense the contracts may simplify production and marketing decisions, thus improving the farming effectiveness.

Finally, our findings show that the education of farmer has some influence on the type of marketing relationship chosen by the farm, whereas age and gender are not significantly associated with farm's integration level. In addition, the CF' farmer is in prevalence enrolled in farm's activities highlighting, once again, a more professionalism of such farms.

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